Grain Dryers

NOTE: Grain dryers, as described here, generally refers to those at grain *storage* facilities. Other types of grain dryers, such as those at ethanol plants, are generally modeled as point sources.

Grain storage dryers are very open structures. Air, usually heated, is blown through the dryer and typically exits the porous sides.

One approach is to model the emissions from each opening as a volume source. The parameters are:[1]

Release height = height above ground of middle of opening
Initial lateral dimension = σ_{Yo} = width of opening / 4.3
Initial vertical dimension = σ_{Zo} = height of opening / 2.15

Note that this is a (horizontal) discharge at elevated temperature. Since it is modeled as a volume source, rather than a point source, neither buoyant plume rise or building downwash effects will be computed by the model. These effects may roughly counter-balance each other, so the results may be considered acceptable.

In the case of column-style dryers the emissions are distributed across a rather large vertical distance. Column dryers also generally have an air intake in the lower third of the column, restricting emissions to the upper two thirds of the column. These effects can be accounted for by stacking several volume sources on top of each other, making sure that the release height of each is adjusted to evenly space them in the upper two thirds of the column. The number of volumes to use is determined by dividing the height of the upper two thirds of the dryer column by the dryer's width. The initial lateral and vertical dimensions are calculated based on the width of the dryer column and the height of the section of the dryer that each source represents.

An alternative approach is to model the dryer emissions as a point source. The exit velocity is set equal to 0.001 m/sec (minimizes plume rise due to momentum). The actual stack diameter is retained rather than adjusting it to an "effective diameter" based on the flow rate.[2] The plume-rise equation can now compute a buoyancy-induced plume rise based on the elevated temperature of the effluent.

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[1] This assumes there are defined areas of emissions from the dryer. If not, use the dryer housing dimensions in the equations to determine release height and initial plume dimensions.

[2] AERMOD Implementation Guide, October 19, 2007 Revision. The PRIME algorithms use the stack diameter to define the initial plume radius which, in turn, is used to solve conservation laws. Using the actual diameter along with a very small exit velocity will have the desired effect of restricting the vertical momentum flow while avoiding the mass conservation problem inherent with the effective diameter approach. Also, since PRIME does not explicitly consider stack-tip downwash, no adjustments to stack height should be made.